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Evaluation of veterinary laboratory proficiency based on results of interlaboratory comparisons organized by FGBI "ARRIAH" in 2018–2019

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SUMMARY
Laboratory diagnosis is a crucial component in implementation of the set of anti-epidemic measures aimed at contagious animal disease control. The need for unswerving trust in the quality of laboratory performance is a matter of importance not only for service providers and customers, but also for inspecting organizations, accreditation bodies, etc. that establish performance requirements for diagnostic laboratories. Incorrect laboratory test results can lead to a misdiagnosis and, therefore, to grave consequences. One of the forms of experimental verification of a laboratory's performance with a view to determine the laboratory's competence and to verify its compliance with accreditation criteria as part of inspection control of the laboratory's activities is interlaboratory comparison. The laboratory can prove its competence at a particular time, as well as clearly demonstrate how stable the quality of its test results is by summarizing and analyzing the results of its participation in interlaboratory comparisons. The analysis of the results of the interlaboratory comparisons (programmes for detection of causative agents or antibodies to the causative agents of avian influenza, Newcastle disease, rabies, classical swine fever, African swine fever, bluetongue, lumpy skin disease) organized by the FGBI "ARRIAH" for the veterinary laboratories of the Russian Federation in 2018–2019 is presented. The results showed that most of the laboratories had passed the tests successfully. The results submitted by participants were unsatisfactory in some interlaboratory comparison programmes (rabies virus detection using fluorescent antibody technique; detection of avian influenza, classical swine fever and lumpy skin disease viruses using polymerase chain reaction). That highlights the need for those participants who failed the tests to improve their laboratory testing quality.

Key words: interlaboratory comparisons, infectious animal diseases, polymerase chain reaction, enzyme-linked immunosorbent assay, fluorescent antibody technique.

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Оценка квалификации ветеринарных лабораторий по результатам межлабораторных сличительных испытаний, организованных ФГБУ «ВНИИЗЖ» в 2018–2019 гг.

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РЕЗЮМЕ

Важной задачей при проведении комплекса противоэпизоотических мероприятий, направленных на борьбу с заразными болезнями животных, является лабораторная диагностика. Необходимость в постоянном доверии к качеству работы лаборатории важна не только для исполнителей и заказчиков, но и инспектирующих организаций, органов по аккредитации и др., которые устанавливают требования к деятельности диагностических лабораторий. Недостоверные результаты лабораторных исследований могут привести к постановке неправильного диагноза, а значит, и к серьезным последствиям. Одной из форм экспериментальной проверки деятельности лаборатории с целью определения ее компетентности и подтверждения соответствия критериям аккредитации при инспекционном контроле за ее деятельностью являются межлабораторные сличительные (сравнительные) испытания. Обобщая и анализируя результаты участия в межлабораторных сличительных испытаниях, лаборатория может не только подтвердить свою компетентность в конкретный момент, но и наглядно продемонстрировать, насколько стабильно качество результатов ее анализов. Представлен анализ результатов межлабораторных сличительных испытаний, организованных в 2018–2019 гг. ФГБУ «ВНИИЗЖ» для ветеринарных лабораторий России, по программам выявления возбудителей или антител к возбудителям гриппа птиц, ньюкаслской болезни, бешенства, классической чумы свиней, африканской чумы свиней, блютанга, заразного узелкового дерматита крупного рогатого скота. Результаты показали, что большинство лабораторий успешно справились с испытаниями. Неудовлетворительный результат был получен участниками по отдельным программам межлабораторных сличительных испытаний (выявление вируса бешенства методом флуоресцирующих антител; выявление вирусов гриппа птиц, классической чумы свиней и заразного узелкового дерматита крупного рогатого скота методом полимеразной цепной реакции). Это указывает на необходимость повышения качества лабораторных исследований не справившихся с заданием участников.

Ключевые слова: межлабораторные сличительные испытания, инфекционные болезни животных, полимеразная цепная реакция, иммуноферментный анализ, метод флуоресцирующих антител.

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INTRODUCTION

Several regions of the Russian Federation retain the status of infected with respect to some infectious animal diseases. Effective control of contagious diseases requires a completes set of anti-epidemic measures with laboratory diagnosis being one of its crucial components. Incorrect laboratory test results can lead to grave consequences. The need for unswerving confidence in laboratory performance quality is a matter of importance not only for service providers and customers, but also for inspecting organizations, accreditation bodies, etc. that establish performance requirements for diagnostic laboratories [1].

One of the ways to evaluate laboratory performance is interlaboratory comparison (ILC). This form of laboratory proficiency testing is widely used, includingin international practice [2]. In addition to the monitoring of test result reliability, the objectives of interlaboratory comparisons are the identification of problems in the work of the laboratory and differences between laboratories, the determination of effectiveness and comparability of test or measurement methods, and a number of others. Successful participation in interlaboratory comparisons helps the laboratory gain more trust from customers. Besides, participation in interlaboratory comparisons is mandatory for the laboratories accredited in the national laboratory accreditation system [3, 4].

The Rosselkhoznadzor subordinate FGBI "Federal Centre for Animal Health" (FGBI "ARRIAH") is accredited in the national accreditation system as an ILC provider according to GOST ISO/IEC 17043-2013 (Certificate of Accreditation No. RA.RU.430258, date of entry into the registry of accredited persons: March 16, 2018). In 2019, the competence of the FGBI "ARRIAH" as an ILC provider was confirmed following the results of the on-site audit (Order of the Federal Service for Accreditation (RusAccreditation) No. PK1-1180 dated June 21, 2019).

Interlaboratory comparison programmes developed by the ILC provider in accordance with the approved scope of accreditation allow for verification of laboratory proficiency in the diagnosis of highly dangerous infectious animal diseases using such methods as polymerase chain reaction (PCR), enzyme-linked immunosorbent assay (ELISA) and fluorescent antibody (FA) technique.

The aim of the paper is to analyze the results of the ILC rounds organized by the FGBI "ARRIAH" in 2018–2019.

MATERIALS AND METHODS

The results of the interlaboratory comparisons organized by the FGBI "ARRIAH" in 2018–2019 under the following 10 programmes were used for the paper:

– detection of avian influenza type A virus RNA;

– detection of antibodies to avian influenza type A virus using ELISA;

– detection of antibodies to Newcastle disease virus using ELISA;

– detection of rabies virus antigen using fluorescent antibody technique;

– detection of antibodies to African swine fever virus using ELISA;

– detection of African swine fever virus genome;

– detection of antibodies to classical swine fever virus using ELISA;

– detection of classical swine fever virus genome;

– detection of antibodies to bluetongue virus using ELISA;

– detection of lumpy skin disease virus genome.

Pursuant to the approved interlaboratory comparison plan, one round of interlaboratory comparisons was carried out for each programme annually. The Split-Sample Scheme was applied: identical control samples prepared from the same material or a specially prepared material split into two or more parts were used, so that each ILC participant could test the control samples from this set of samples [1]. All control samples are validated in terms of assigned values, homogeneity and stability in strict compliance with the procedure approved by the ILC provider.

Data obtained for each ILC programme are provided in detail in the reports that are available in the Interlaboratory Comparisons section on the web-site of the ILC provider (FGBI "ARRIAH") (http://www.arriah.ru/main/lprovedenie-msi). Information about participants is presented in anonymized form.

RESULTS AND DISCUSSION

The proficiency of 46 veterinary laboratories located in 37 regions of the Russian Federation with respect to diagnosis of seven dangerous animal diseases (avian influenza, Newcastle disease (ND), rabies, classical swine fever (CSF), African swine fever (ASF), lumpy skin disease (LSD), bluetongue) using PCR, ELISA and fluorescent antibody technique was evaluated based on the results obtained within the ILC programmes. The consistency of submitted results with the assigned values for the coded control samples served as a criterion for evaluation. The ILC result was considered satisfactory when all the control samples in the panel were correctly identified. All the ILC programmes were based on the qualitative analysis of the assigned control sample. When at least one control sample did not agree with the assigned value, the ILC result was recognized unsatisfactory.

Table 1 shows the total number of participating laboratories for each ILC programme of 2018–2019 and the number of participants that made mistakes and failed the tests.

Data presented in Table 1 show that inconsistent results were identified amongthe ILC results for 4 out of 10 implemented programmes. These programmes required the use of fluorescent antibody technique or PCR. At the same time, the participants of all the ILC programmes for the detection of infectious animal disease agents with ELISA passed the tests successfully using commercial test kits produced by domestic and foreign manufacturers.

The greatest number of mistakes were found to have been made by the participants of the proficiency tests related to the detection of rabies virus antigen using fluorescent antibody technique which is the main tool for rabies diagnosis (90.7% of laboratories passed the test). The unsatisfactory ILC results with respect to the diagnosis of this deadly animal and human disease are particularly troubling in the light of unfavorable rabies epidemic situation across much of Russia's territory. It is important to note that fluorescent antibody technique requires the high qualifications and experience of personnel, as well as the appropriate maintenance of fluorescence microscopes (timely replacement of lamps, etc.). Besides, at least two specialists should be involved in the interpretation of fluorescent antibody test results.

As for the ILC programmes for the detection of avian influenza, CSF and LCD viruses using PCR, the percentages of the laboratories that passed the tests were 96.2, 94.1 and 93.9%, respectively, out of the total number of participants. PCR procedure comprises several stages (sample preparation, nucleic acid isolation, PCR as such, the interpretation and analysis of results), and this increases the likelihood of making a mistake at any of its stages and producing an unsatisfactory final result. This technique

Table 1
Results of interlaboratory comparison programmes carried out in 2018–2019

Таблица 1
Результаты реализации программ МСИ за 2018–2019 гг.

No.	Parameter according to the scope of accreditation (corresponds to a particular ILC programme)	Test method	Number of participants*	Participants that passed the ILCs successfully	
				number	percentage of the total number
1	AI type A virus RNA	PCR	26	25	96.2
2	Antibodies to AI type A virus	ELISA	10	10	100
3	Anti-NDV antibodies	ELISA	6	6	100
4	Rabies virus antigen	MA	43	39	90.7
5	Anti-ASFV antibodies	ELISA	10	10	100
6	ASFV genome	PCR	17	17	100
7	Anti-CSFV antibodies	ELISA	34	34	100
8	CSFV genome	PCR	51	48	94.1
9	Antibodies to bluetongue virus	ELISA	6	6	100
10	LSDV genome	PCR	49	46	93.9

* In a case where a laboratory participated in the interlaboratory comparisons twice (in 2018 and 2019), it was recorded as two participants.

Table 2
Mistakes made by participants of interlaboratory comparison rounds in 2018–2019

Таблица 2
Ошибки участников раундов МСИ в 2018–2019 гг.

No.	Parameter according to the scope of accreditation (corresponds to a particular ILC programme)	Test method	Number of participants that failed the ILC	Type of mistake	
				false positive result	false negative result
1	AI type A virus RNA	PCR	1	0	1
2	Rabies virus antigen	FA technique	4	1	3
3	CSFV genome	PCR	3	0	3
4	LSDV genome	PCR	3	0	3

requires a particularly high qualification and the availability of specialized rooms.

When the result is unsatisfactory, the participating laboratory is encouraged to review the adopted test procedure, to identify the possible causes of mistakes, and to develop adequate corrective actions (further training of the staff; the enhanced control of the tests performed; the repair or replacement of equipment and measuring tools; diagnostic kit replacement, etc.). The effectiveness of corrective actions should be confirmed by the laboratory's repeated participation in the interlaboratory comparisons at the earliest possible time.

Table 2 shows mistakes made by the participants of ILC rounds in 2018–2019.

Data in Table 2 show that most of mistakes were related to false negatives, i.e. the control samples that contained a disease agent or antibodies to it were characterized as negative ones. Such mistakes in laboratory diagnosis can have grave consequences such as late diagnosis, underestimation of the disease spread risk and, consequently, reduce the effectiveness of anti-epidemic measures.

Even a well-managed laboratory comprising experienced personnel can sometimes produce unsatisfactory test results. Monitoring is of particular importance for evaluation of test result reliability; it can be carried out not only through interlaboratory comparisons, but also by means of intralaboratory controls (repeated tests of samples under standard conditions, the use of alternative equipment, performance of the same test by a different staff member, the use of the diagnostic test kit from a different manufacture for testing, etc.). However, even with existence of internal controls, the laboratory is obliged to monitor its performance by means of comparison with other laboratories' results, i.e. through participation in interlaboratory comparisons [3]. The laboratory's proficiency shall be evaluated taking into account the results of the previous rounds of tests, the frequency of its participation in interlaboratory comparisons, the level of coverage of the laboratory's scope of activities by proficiency testing programmes, the ability of the personnel to use the results of participation in interlaboratory comparisons to improve the laboratory's performance, etc. [5]. Continuous satisfactory results of the laboratory's participation in interlaboratory comparisons can be indicative of its high competence in performing particular types of tests.

After having eliminated existing mistakes, all the participants of the ILC rounds organized by the FGBI "ARRIAH" that had failed the 2018 tests participated in the comparisons again in 2019 and produced satisfactory results.

CONCLUSION

The analysis of the results of the veterinary laboratory proficiency tests organized by the FGBI "ARRIAH" in 2018–2019 demonstrated that most of the participants had passed the tests successfully. The proficiency of some laboratories was recognized unsatisfactory mainly because of the false negative results produced by them. The greatest number of mistakes was made by the ILC participants within the programmes for rabies virus antigen detection using fluorescent antibody technique: 90.7% of laboratories passed the test successfully. Besides, unsatisfactory results were presented by the participants of the ILC programmes for detection of avian influenza, CSF and LSD viruses using PCR (96.2, 94.1 and 93.9% of laboratories, respectively, passed the tests). The data obtained indicate the existence of mistakes in the laboratory diagnosis of infectious animal diseases as regards some participants that failed the interlaboratory comparisons, as well as highlight the need for actions to improve their laboratory test quality. Diagnostic laboratories should pay more attention to the internal control of their testing quality (preferably, using reference samples) and the control of the diagnostic test kits they use, carry out verification of the diagnostic techniques employed and ensure the adequate level of knowledge and skills of the personnel involved.

REFERENCES

1. GOST ISO/IEC 17043-2013. Conformity assessment. General requirements for proficiency testing. M.: Standartinform; 2014. 34 p. Available at: http://docs.cntd.ru/document/1200108187. (in Russian)

2. Decision of the Board of the Eurasian Economic Commission No. 12 dated January 26, 2016 on approval of the Procedure for organization of interlaboratory comparison tests (interlaboratory comparisons) [Reshenie Kollegii Evrazijskoj ekonomicheskoj komissii ot 26 yanvarya 2016 g. № 12 «Ob utverzhdenii Poryadka organizacii provedeniya mezhlaboratornyh sravnitel'nyh ispytanij (mezhlaboratornyh slichenij)»]. Available at: http://docs.cntd.ru/document/420333646.(in Russian)

3. GOST ISO/IEC 17025-2009 (ISO/IEC 17025-2005). General requirements for the competence of testing and calibration laboratories. M.: Standartinform; 2012. 28 p. Available at: http://docs.cntd.ru/document/gost-iso-mek-17025-2009.(in Russian)

4. Order of the Ministry of Economic Development and Trade of the Russian Federation No. 326 dated May 30, 2014 "On Approval of Criteria for Accreditation, the List of Documents Confirming the Compliance of

the Applicant, Accredited Person with Accreditation Criteria and the List of Documents in the Field of Standardization, the Requirements of which Shall be Observed by Applicants, Accredited Persons to Ensure their Compliance with Accreditation Criteria (as amended on August 19, 2019) [Ob utverzhdenii Kriteriev akkreditacii, perechnya dokumentov, podtverzhdayushchih sootvetstvie zayavitelya, akkreditovannogo lica kriteriyam akkreditacii, i perechnya dokumentov v oblasti standartizacii, soblyudenie trebovanij kotoryh zayavitelyami, akkreditovannymi licami obespechivaet ih sootvetstvie kriteriyam akkreditacii (s izmeneniyami na 19 avgusta 2019 goda)]. Available at: http://docs.cntd.ru/document/420203443. (in Russian)

5. Kartashova A. V., Khalikov M. R. Interlaboratory comparisons as criterion for accreditation. *Kontrol' kachestva produkcii*. 2015; 1: 27–30. (in Russian)

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